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SUMMARY - This report considers possible economic advantages the US might give up as a result of proposed exchanges with the Soviets in bilateral agreements concerning geology, vegetation, soils, land use, oceanology, water, snow, glaciology, and microwave techniques for remote sensing.

1. There has been some concern regarding possible economic advantages the US might give up as a result of proposed exchanges in the US-USSR Bilaterals on the Natural Environment. The area of geology is of particular concern. The entire matter was thoroughly reviewed by the NSC Under Secretaries Committee on 14 September 1973. It will be US policy to operate within the understandings upon which the findings of 14 September were based and upon which the US participants were authorized to continue. Outlined below is a review of the total status of relationships and agreements.

2. The area of vegetation, soils, and land use is singled out for emphasis in the original agreement. No joint project has been initiated although it is proposed that the cooperative effort for the future "be directed to develop the methodology for using remote sensing to reveal soil and vegetation productivity." Analogous test sites were identified in the US and USSR as was the following vegetation for study: pasture land, wheat, barley, desert scrub, and meadow grasses. According to Khodarev (USSR), the delay is due to the time that it is taking the Academy of Sciences of the USSR to enlist the support of the appropriate Soviet Ministries. He indicated he is actively pursuing this support and hopes to be able to respond by the end of this year (1973). He was encouraged in this as much as possible but the US has not gone to the point of saying that cooperation in other areas must be delayed pending establishment of a joint project in this area. This could be done if the US feels it is important enough. From a programmatic

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viewpoint, it is desirable to push hard for cooperation in this area but not to the extent of making it a sine qua non for cooperation in the other areas.

3. During a meeting with Khodarev in Baku in October 1973 the US was informed that the Soviets have taken considerable multi-spectral data from an aircraft over a diverse agricultural area in Fergana, USSR (71°00' -73° 30' E, 41° 30'-43°00' N). Zonov asked if the US had any ERTS-1 data of the area. (The bilateral makes no provision for exchange of data the US acquires over USSR territory or vice versa--the US may want to reconsider if the Soviets ask the US to obtain ERTS data.) Another relevant piece of information which should be taken into account in the US assessment of where it stands in this area is the recent acknowledgement in Izvestiya (30 September 1973) that Soyuz 12 "on the seventeenth revolution undertook a survey using a special nine-lens camera. The filters for these lenses make it possible to obtain photographs in different parts of the spectrum." On the basis of the above, the US should expect a response with an adequate quid pro quo in the area soon.

4. The principal development in oceanology has been the cooperative Bering Sea expedition. This project was moved from the working group on the natural environment to the working group on meteorology by mutual consent because of the organizational attachments of the Soviet principals to their Hydrometeorological Service. Data exchange from this effort has been accomplished. A meeting took place at GSFC between Nordberg and his counterpart Kondratyev and associates during which initial results were discussed.

5. In oceanography, the Soviets have not been able to contribute any spacecraft measurements. (It is presumed that they do not currently have a satellite capability in this area.) Both sides agreed that since there was not an optimum complement of instruments on both ships and aircraft at present "it is desirable to conduct joint, synchronous ship and aircraft measurements of sea surface conditions and radiances in (visible, infrared, and microwave) spectral regions during the 1974 Tropical Atlantic Experiment." The Soviets had offered to make use of their surface ships in 1973 to acquire ground truth for comparison with US satellite observations (already in the public domain). Since their ships could make only temperature and ocean color measurements (and could not relate ocean color to biological content of the water), the US said this was of limited interest. The US did, however, ask the Soviets to advise the US of the tracks of Soviet ships and stated that the US would examine the availability of satellite data and then determine US interest. The Soviets did provide accurate tracks of a. their research ship, the Akademic Kurchatov, and b. some fishing ships. The US has asked for specifics on the data acquired to determine US interest.

6. The Kurchatov charted surface temperatures along the track and for an array of points 20 Km either side of the track. Dr McClain (National Oceanic and Atmospheric Administration) is looking at the potential of using this data to compare surface temperatures derived from NOAA-2 data. The fishing ships acquired temperature, ocean color, and water turbidity across a 200-mile path covered by ERTS-1 observations. When the US receives specifics of these measurements, Nordberg will examine utility as ERTS ground truth and will advise.

7. In the area of water, snow, and glaciology the US made two suggestions for

cooperative effort:

a. A comparison of a remote sensing derived hydrologic model of a Soviet river basin with that of a US river basin (Tennessee River);

b. Determination of the factors influencing ground water inference from space data.

The Soviets have not responded in this area. Khodarev stated in Baku that he did not think he could get together the required capability--both in terms of expertise and computer. (He probably meant programming talent.)

8. Two activities in microwave remote sensing techniques have been pursued under the working group on the natural environment. It was agreed to exchange US and USSR satellite microwave observations to attempt the following:

a. An explanation of variations of radio brightness over polar ice due to ice types;

b. An explanation of variation of radio brightness over uniform continental terrain due to temperature, moisture, and topographic changes;

c. The derivation of climatic patterns of atmospheric gaseous and liquid water.

The USSR sent the US Cosmos 243 data acquired in September 1968 over previously agreed upon areas. This is radiometric data at wavelength of 8 cm, 3 cm, 1.3 cm, and 0.8 cm. The US responded with Nimbus 5 data taken in September (same time of year) 1973 over the same areas. It consists of 1.5 cm imagery. There is some possibility that data taken in different years over areas where climatic conditions are sufficiently stable can be correlated. Progress in analysis of this data is to be discussed at the next meeting of the working group.

9. The most definitive program, and the only one to date nearing detailed agreement, is a cooperative project in which the objective is to have both countries plan and execute an aircraft program to "determine the relationship between microwave emissivity and soil moisture content at various wavelengths for varying soil types, vegetation cover, and surface roughness and for varying moisture distribution with soil depth". In this area, neither country is ahead. The US is starting from ground zero. Agreement has been reached on the frequencies to be investigated and the conditions over which data is to be acquired. It remains for Nordberg and his counterpart Basharinov to provide a recommended schedule for the execution of the program and plan milestones for comparison of effort and exchange of specific results. If executed as currently conceived, it will be an honest program of real mutual benefit.

10. Geology seems to be one of the most active areas of Soviet interest. This could be based on economic and commercial considerations. It probably occurs because the "experts" and organizations immediately available to the Academy of Sciences of the USSR just happen to be geologists and they have not yet been able to tap adequate sources in other disciplines. The technical exchanges which have taken place have been more competent in this area (and in the microwave area) than in other areas. Mr Fischer (Geological Survey, Department of the Interior) and his counterpart Dr Trifonov (Institute of Geology, USSR Academy of Sciences) have been instructed to focus the

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activities on a more limited area of geology than previous general discussions indicated so that the US could better insure truly corresponding efforts. Objectives for this focus were recommended by them as follows:

a. Development of aids for the detection and analysis of tectonic lineaments expressed on aerial and space photographs through the use of diffraction gratings and other spacial filtering techniques;

b. Definition of recognition methods for tectonic linears with the objective of developing a classification system for linears;

c. Development of better understanding of relationships between surface features visible on space images and previously known geologic subsurface structure.

Regarding discussions on the first two of the geologic objectives, the USSR appears to be volunteering some real contributions. First, regarding the development of devices to aid in the detection of lineaments, the US proposed the use of a specific optical (Ronchi) grating which would emphasize only linear features. The USSR is proposing also to look at the utility of other graphical filters in the detection of non-linear features such as ring features. It was in this content that they proposed studying salt domes since these are potentially represented by circular surface features. Secondly, objective b above is a USSR suggestion. No one in the US is considering the possibility of being able to classify surface linears in terms of the geologic age of the fault causing the linear. The Soviets apparently would like to attempt this. It stems from a finding which they made and reported rather obscurely in a report provided to the US which notes that oil and gas deposits are localized at "places of crossing of young latitudinal faulting zones with more ancient, often meridional faults". It is reported that since the Soviets printed this they have looked a bit at Alaskan fields and believe they will find similar occurrences of faults of different ages associated with potential oil and gas deposits.

11. Fischer and Trifonov are to develop a plan for the accomplishment of the three objectives in this area for the approval of the USSR and the US. In order to contain and definitize the program, the US is pressing for an identification and location of the specific subsurface structures to be studied for objective c. It would be most desirable if similar subsurface features in the two countries were studied by the two groups so that results can be directly related. Typical of the kinds of subsurface structures being considered are: fractures at varying depths, folded anticlines, trenches in deep basement rock, salt domes, etc. All of these types of structures may or may not be related to mineralization or gas and oil deposits. Herein may lie some concern.

12. The potential advantages to the USSR of bilateral cooperation in geology and agriculture were critically reviewed by the NSC Under Secretaries Committee. In stating the problem, they acknowledged that "Economic and commercial implications arise from the fact that data derived from space observations could aid in such activities as, for example, estimating world grain harvests and locating potential mineral deposits." In their findings, they recognized "the open availability and basically scientific nature of the information that NASA has exchanged and proposes to exchange. We conclude there is no basis for concern." Only already authorized and contracted investigations will be used as the US contribution to any resulting bilateral effort. These investigations are committed to open publication of results, and the US will insure such disclosure has taken place prior to any exchange of results.

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13. There is only one area of all those considered by the US working group on the natural environment in which a new effort will have to be generated. This is in the microwave/soil moisture research proposal. The US would also adhere to the public-disclosure-before-exchange ground rule for this effort.

14. In Summary:

a. The US should expect a positive response soon in agriculture;

b. The Bering Sea Experiment was successfully executed, with potentially useful results. Further substantive effort in oceanography will probably occur in conjunction with the Tropical Atlantic Meteorological Experiment in 1974;

c. We expect no response in hydrology;

d. The proposed program to develop microwave techniques is a good cooperative program with real, mutual benefit possible;

e. Soviet participants in the working group have come mainly from the geological community. This subject has been too broadly considered in the past; efforts are underway to focus on analysis of relationships lineaments to subsurface structure;

f. The US can expect Soviet contributions to move toward use of multi-spectral space data in the near future. They may ask for ERTS data over Soviet sites although not permitted by agreement.

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